

PATENT COOPERATION TREATY

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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY


(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

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Applicant's or agent's file reference 03 01 732 285		FOR FURTHER ACTION		See Form PCT/PEA/416
International application No. PCT/DK2004/000736		International filing date (day/month/year) 26.10.2004	Priority date (day/month/year) 27.10.2003	
International Patent Classification (IPC) or national classification and IPC H05K7/20, H01L23/473, F28F3/12				
Applicant DANFOSS SILICON POWER GMBH				
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 6 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> sent to the applicant and to the International Bureau a total of 1 sheets, as follows:</p> <p><input type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>				
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the opinion</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input type="checkbox"/> Box No. VIII Certain observations on the international application</p>				
Date of submission of the demand 18.08.2005		Date of completion of this report 10.10.2005		
Name and mailing address of the international preliminary examining authority:  European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016		Authorized Officer Toussaint, F Telephone No. +31 70 340-3066		



**INTERNATIONAL PRELIMINARY REPORT
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International application No.
PCT/DK2004/000736

Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
 - ☐ publication of the international application (under Rule 12.4)
 - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

Description, Pages

1-7 as originally filed

Claims, Numbers

1-4 received on 18.08.2005 with letter of 18.08.2005

Drawings, Sheets

1/4-4/4 as originally filed

- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing
3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing (*specify*):
 - ☐ any table(s) related to sequence listing (*specify*):
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
- ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing (*specify*):
 - ☐ any table(s) related to sequence listing (*specify*):

* If item 4 applies, some or all of these sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT
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Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	1-4
	No: Claims	
Inventive step (IS)	Yes: Claims	1-4
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1-4
	No: Claims	

2. Citations and explanations (Rule 70.7):

see separate sheet

Re Item V

**Reasoned statement with regard to novelty, inventive step or industrial applicability;
citations and explanations supporting such statement**

Reference is made to the following documents:

D1: DE 202 08 106 U1 (DANFOSS SILICON POWER GMBH)

D2: GB-A-2183304 (DIESEL KIKI CO. LTD)

1. INDEPENDENT CLAIM 1

1.1 Novelty (Art. 33(2), PCT)

The document D1 is regarded as being the closest prior art to the subject-matter of claim 1 and shows (the references in parentheses applying to this document):

D1 discloses:

A distributor For distributing a flow of liquid over a surface to be cooled, the distributor comprising:

- an inlet manifold (8);
- an outlet manifold (9); and
- at least one flow cell (7) connected between the manifolds, the flow cell comprising:
 - a cell inlet (5) in fluid communication with the inlet manifold;
 - a cell outlet (6) in fluid communication with the outlet manifold;
 - a main flow channel formed by wall segments (21) extending from a base to the surface to be cooled and as a meandering sequence of channel segments for guiding a main flow of liquid from the cell inlet (5) along the surface to the cell outlet (6) with a plurality of changes in the direction of the main flow;

The subject matter shown in D1 therefore differs from that of amended claim 1 in that D1 does not disclose:

- a bypass flow channel formed by gaps between the wall segments and the surface to be cooled for allowing a bypass flow of liquid from the cell inlet to the cell outlet; wherein the bypass flow channel interconnects the channel segments of the main flow channel.

It is therefore submitted that claim 1 is novel in view of D1.

1.2 Inventive step (Art. 33(3), PCT)

As mentioned above, the subject matter of amended claim 1 differs from that shown in D1 in that it does not disclose:

- a bypass flow channel formed by gaps between the wall segments and the surface to be cooled for allowing a bypass flow of liquid from the cell inlet to the cell outlet;

wherein

- the bypass flow channel interconnects the channel segments of the main flow channel.

The problem to be solved by the present invention, when starting from D1, is that of increasing the transfer of heat from the plate to be cooled to the fluid.

According to the present invention this is solved by modifying the height of the wall segments so that a small gap is left between the wall segments and the surface to be cooled. This increases the turbulence of fluid within the cells and thus increases the heat transfer.

When starting from D1 and faced with the problem stated above, the skilled person would not attempt to decrease the height of wall segments, since there is no discussion in D1 of turbulence, or its effect on heat transfer, or indeed, that decreasing the height of the wall segments would enhance the cooling effect.

Therefore it would not be obvious to a person skilled in the art to modify the cooling device of D1 in order to solve the above problem and in such a way that the invention as defined in claim 1 is reached.

If the skilled person consults D2 in search of a solution to the problem, he would still not arrive at the invention claimed in amended claim 1 since D2 does not disclose explicitly a bypass flow channel formed by gaps between wall segments and the surface to be cooled.

Rather, the skilled person when consulting D2 would learn that in order to increase the transfer of heat, he should increase the entire surface area of the surface to be cooled (D2 page 2 lines 49-51) by the use of elongated projections or ribs. Such structures, he would learn, should be attached to the inner side of the top plate (3 in D1), since this is the surface requiring cooling. In addition, he would learn that a smooth (i.e. not turbulent) flow of fluid is to be desired (D2 page 1 lines 43-44, page 2 lines 47-49) and would thus be discouraged from making modifications that might increase turbulence. Thus, it is respectfully submitted that amended claim 1 involves an inventive step over D1 and in view of D2.

2. DEPENDENT CLAIMS 2-4

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(SEPARATE SHEET)**

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Claims 2-4 are dependent on claim 1 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

AMENDED CLAIMS

1. A distributor for distributing a flow of liquid over a surface to be cooled, the distributor comprising:

- an inlet manifold (8, 25);
- an outlet manifold (9, 24); and
- at least one flow cell (7) connected between the manifolds, the flow cell comprising:
 - a cell inlet (5) in fluid communication with the inlet manifold;
 - a cell outlet (6) in fluid communication with the outlet manifold;
 - a main flow channel (50) formed by wall segments (21) extending from a base (25) to the surface to be cooled and as a meandering sequence of channel segments (64, 63, 62, 61) for guiding a main flow of liquid from the cell inlet (5) along the surface to the cell outlet (6) with a plurality of changes in the direction (51, 52) of the main flow; and
 - a bypass flow channel (71, 72, 73) formed by gaps between the wall segments and the surface to be cooled for allowing a bypass flow of liquid from the cell inlet to the cell outlet; wherein
- the bypass flow channel interconnects the channel segments of the main flow channel.

2. A distributor as in claim 1 wherein a plurality of flow cells is interconnected between the manifolds, and wherein each of the flow cells comprises a bypass flow channel.

3. A liquid-coolable unit for removing heat from a heat source, the unit comprising a plate heated by the heat source and a distributor as in any preceding claim for distributing a flow of cooling liquid over a surface of the plate.

4. A liquid-coolable electronic unit, the unit comprising an electronic circuit encapsulated in a circuit module having an outer surface, and a distributor as in any one of claims 1 to 2 for distributing a flow of cooling liquid over the surface.